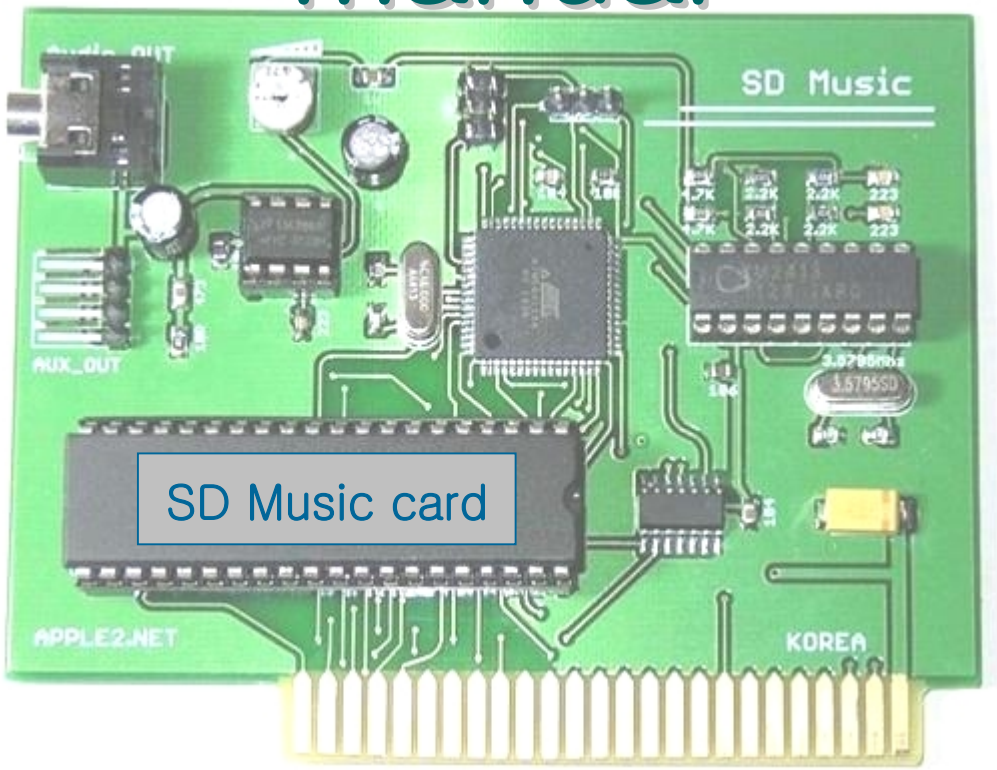
SD Music card user's manual



SD Music card

http://www.apple2.net

Prolog

- Our APPLE II has a speaker and can make some simple beep sound and CPU must handle every tics to generate sound, Due to these difficulties, new sound card appeared name of Mocking board I, II, A,C but, so long time ago and discontinued.

  During long time, It was my the only sound card for APPLE II and I can't find another sound card Of course I can have a Passport card but it isn't soundcard. It is just MIDI interface.
  After research both FM chip , AY3-8910 and 6522 functions, I could design new sound card it is the SD Music card.

  It isn't just new sound card with new chip sets. If we need new program or new game(?) , it would be useless that's why It is compatible as our classic mocking board but, much better musical instruments.

- The SD Music card integrated with new technologies to drive FM chips(YM2413).
- You can use this card on APPLE II, II+, //e even IIGS but, as we know, Mocking board doesn't work well with APPLE IIGS and have same compatible issue.
- It can produce 9 channels of sound and 8 channels are used for mocking board channel and the last one is used for noise emulation.
- But mocking board have limitations and not very good to drive YM2413, For drive all functions of Ym2413 sound chip, It provide 'Native mode' with this mode, you can control YM2413 almost of al l functions and there are no limitations as mocking board compatible mode. For example you can use 5 percussion sounds and can add one user music instruments and can change to another mu sic instruments.
- If you are good at the programming on APPLE II, You can make good music player or music conv erter.

Installation

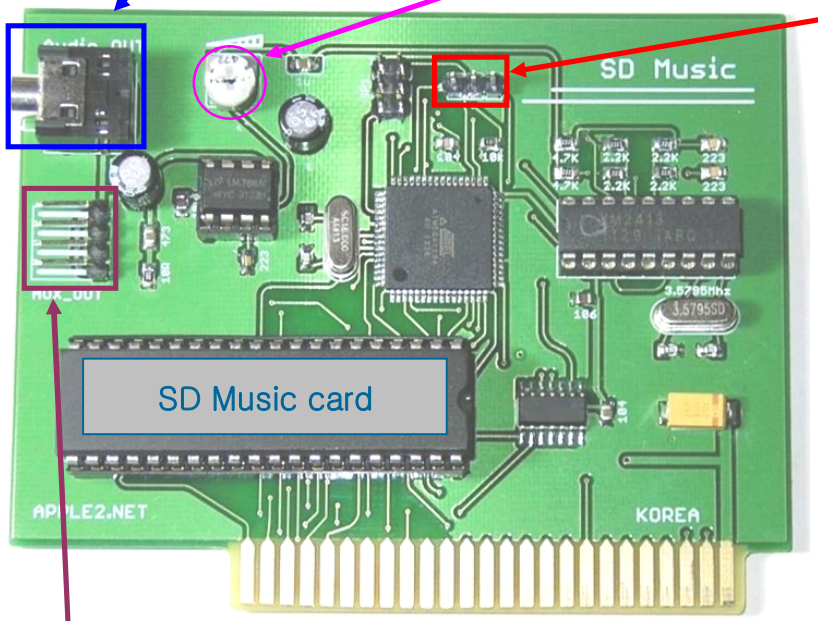
☞WARNING

- Before to connect SD Music card, Please **unplug power cord** both APPLE II and your audio Amplifier to connect SD Music card.

- Then you can use Audio out or AUX_Out for Audio amplifier or Audio IN TV set.

- **Audio Out**; Standard 3.5mm Audio signal output
- **Aux_out**; Internally Bridged with Audio out. Just different shape of connector. Side pins are intentionally cut shortly.
- **Variable resistor**: For sound volume control. CW is louder CCW is softer (Default is Maximum)

SD Music connection and set default



3.5mm Audio out jack

Variable resistor for Sound volume control

Switch block used to for default configuration.

- 1 2-3 : Set to SD Music instrument default.
  When you turn on the APPLE II, It will return to SD default. (Factory default)
  2 noise channel, one sub channel.

AUX Audio output
Audio out
GND
GND
Audio out

Music instrument assign Utility

- You will receive this image file which is a utility for assign music instruments of SD Music card. You need to transfer this utility to your APPLE II via ADT or SD DISK][Emulator. But, if you having difficulty, you just can make simple one as next page.

- Run the Image.
- You can select channel which you want to change music instruments.
  (It doesn't show present music instruments sorry for it.)
  You can select instruments by < > keys and set with Return key.
  Then It will store your setting into the EEPROM of SD Music card.
  For exit press ESC key

- You need to consider the switch cap, Cause it will return to defaults every Power ON if it has switch cap so, If you want to keep your changes, you have to remove the cap.
- Anyway, this returning to default setting is doing only while the power ON time.

Music instrument configuration

- Simply key-in channel number to change music instruments

- Then use arrow key(<->)to select music instruments then Press Enter.
- Thant's all.. If you want exit, just press ESC..
- Recommended to remove switch block to avoid resetting while the Power ON again.

Mocking board channel

- Mocking board II,A,C are have total 6 channels and each chann el assigned to SD Music card as below.

<Switch block on 2-3 mode>

Mocking board channel	SD Music card Channel	Remarks
1	1(7)	7th is chorus
2	2(8)	8th is chorus
3	3	
4	4	
5	5	
6	6	
1st Noise	9	Noise
2nd Noise	9	Noise

7th channel and 8th channel are used just for chorus and playing with major channel.

Channels assign

- On the mocking board emulation, there are 8 music instruments are assigned for each 6 mocking board channels. Each music instrument assigned in 1 to 6 and two more music instruments are used as chorus on 1 and 2(Switch block 2-3 mode)
  So it is 1(7),2(8),3,4,5,6

- You can change this music instruments array with setting utility or your own simple BASIC code anyways total music instruments are 16 (Noise included)

Simple BASIC source code for Instruments setup

You can use this source code for your SD Music card.

You need to insert SD music card slot in #4

Simple put channel number then Music instruments number.

If channel number is ‘0’ then will end of program.

Channel number is valid 1 to 8 and Music instruments number is valid 0~15

Please refer music instruments table.

```
10 HOME
20 INPUT “CHANNEL?“;C
30 IF C=0 THEN END
40 INPUT “MUSIC INSTRUMENT?“;M
50 S=C*16+M
60 POKE 50306,255:POKE 50307,255
70 POKE 50304,129: POKE 50305,S
80 POKE 50304,255
90 GOTO 20
```

Reference code on Monitor
(n: is slot number)

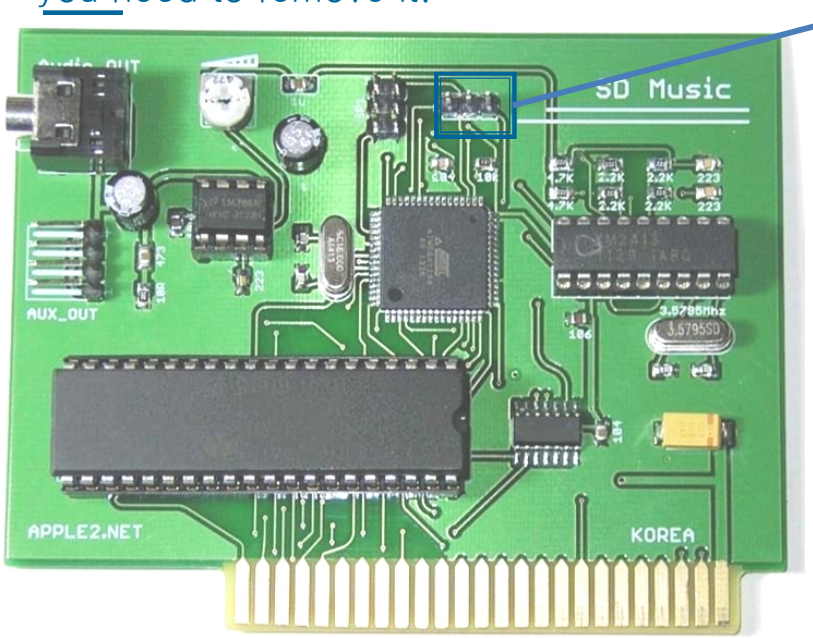
Cn82:FF ‘Set PortB’
Cn83:FF ‘Set PortA’
Cn80:81 ‘Mode for change of instrument’
Cn81: ## ‘Channel/Instrument number’
Cn80:FF ‘End of configuration

Tip for music instruments

- Two type of Music instrument are using on SD Music card. One is concurrent sounding instrument and the other is short period sounding instruments and SD Music card have major 1(7),2(8),3,4,5,6 channel and 7,8 channel is behind of 1 and 2 channel. When 1st channel is playing then 7 channel of music instrument also playing together and 8 channel also playing with channel 2. It named as chorus instruments.
- The major channels(1,2,3,4,5,6) are good playing with concurrent music instrument cause of Some of music using changing volume while the playing sound and sub channel is recommended to assign short period instruments.
- If you assign short period(hit) music instruments to major channel, the sound wasn't good cause of again controlled by volume while the playing decay time.
- And sub channel doesn't control by mocking board volume.
- Sub channel on and off is depend on the switch block configuration.
- If 1-2 on, it doesn't have sub channel, 2-3 on is one sub channel. Open is 2 sub channels.

Return to default music instruments

If there is inserted switch block on SD Music card, it will reset to default music instrument while on the APPLE II. If you want to with your own instruments array, you need to remove it.



- The function is following by switch block position as below.
- 1-2 3 : One music instrument used(Clarinet).little similar as Mocking board.
  2 noise channel, no sub instrument.
- 1 2-3 : Set to SD Music instrument default.
  When you turn on the APPLE II, It will return to SD default. (Factory default)
  2 noise channel, one sub channel.
- 1 2 3 : No switch cap.
  Using previous stored instrument setting. It doesn't change to default. If you want to user defined sets, you need set as this.
  One noise channel, two sub channel

Music instruments channel status

Switch block on 1-2 (Left)

Channel #	Music instrument#	Description
1	5	Clarinet
2	5	Clarinet
3	5	Clarinet
4	5	Clarinet
5	5	Clarinet
6	5	Clarinet
8(1st noise)	0	Noise
9(2nd noise)	0	Noise

- Mocking board similar mode
- No sub channel.
- 2 noise channel on 8,9
- 7 channel not used

Switch block on 2-3 (Right)

Channel #	Music instrument#	Description
1 (7)	4 (2)	Flute / Guitar
2	9	Horn
3	6	Oboe
4	5	Clarinet
5	7	Trumpet
6	8	Organ
8(1st noise)	0	Noise
9(2nd noise)	0	noise

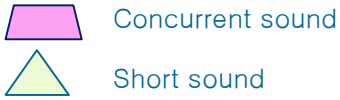
- One sub channel
- 2 noise channel on 8,9

No switch cap

Channel #	Music instrument#	Description
1(7)	No change	No change
2(8)	"	"
3	"	"
4	"	"
5	"	"
6	"	"
9	0	Noise

- Using previous setting
- Using one noise channel as #9
- 2 sub channel activate

List of Music instruments



Tone Data

	Instrument		Instrument
0	User define(Noise)	8	Organ
1	Violin	9	Horn
2	Guitar	10	Synthesizer
3	Piano	11	Harpsichord
4	Flute	12	Vibraphone
5	Clarinet	13	Synthesizer Bass
6	Oboe	14	Acoustic Bass
7	Trumpet	15	Electric Guitar

Control as mocking board

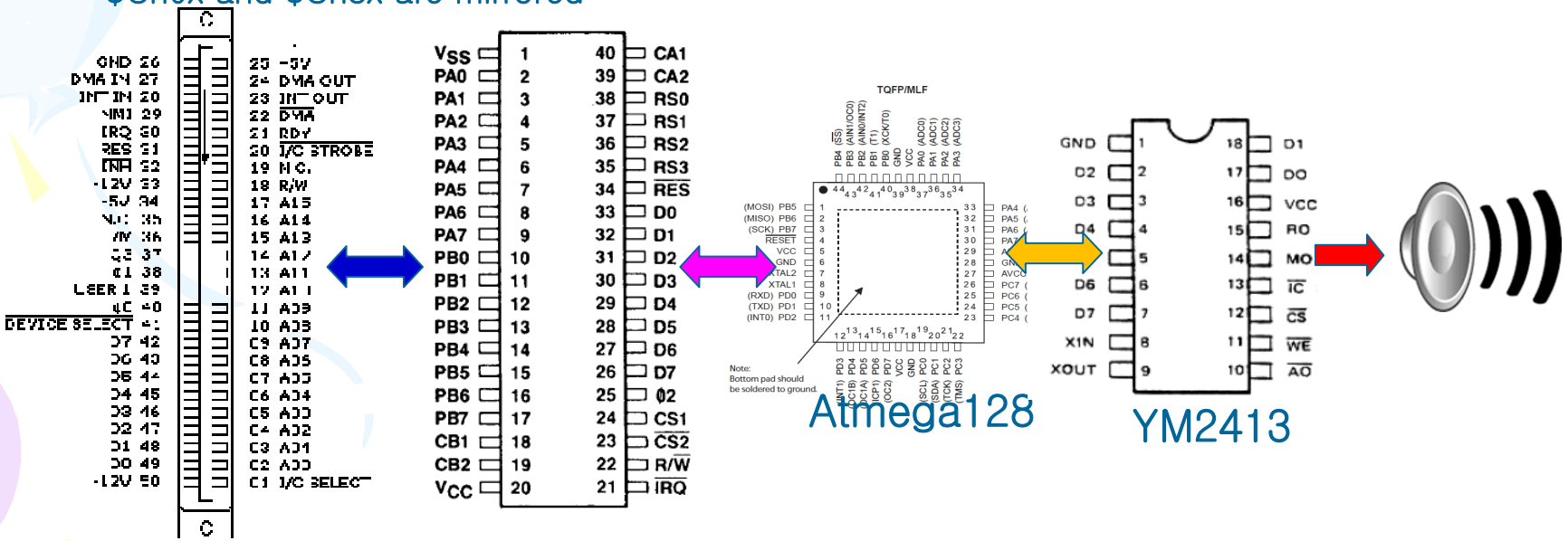
To control mocking board, you need to know how to use 6522. Mocking board have tow 6522 and connection to AY3-8910 as interface device. There are three major functions, Timer ,Interrupts and Port IO.

- Each 6522 has one timer and two IO ports
  - Timer
    - You can use timer interrupts for accurate sound processing, 6522 provide one timer interrupt and 6502 can have proper timing to send next note of your song. You need to learn how to handle this interrupts control and for set it Please refer 6522 manual for it.

- Port A and Port B for AY8910
  - Set AY3-8910 to get register number.
    - Set ay3-8910 register number, Register number must already have on $Cn01 earlier, then this function just set act to sound chip to aware the data is Register number.
  - Store Data
    - Data should store in $Cn01 and send data to previous register number.
  - Reset the sound chip
    - Reset all AY3-8910 Registers. You can use it to reset the chip.

IO Address and diagram

- Mocking-II,A,C have 2 AY3-8910.
  - 1st 6522 is occupied on $Cn0x and 2nd is occupied $Cn8x
    if it used slot #4, $C40x ~ $C48x are occupied.
- Mocking-I has only one AY3-8910
  - Connected on $Cn0x
- SD Music card connected one 6522 and address are mirrored.
  - $Cn0x and $Cn8x are mirrored



Direct control of YM2413

- SD Music card also occupied same address as Mocking board. It occupied $Cn0x to $Cn8x but only one timer and IRQ interrupt.
  - Mocking board compatible mode are following mocking board control.
- If you want to make new music player, I recommended to use this 'native mode' to control all of functions of YM2413. It is similar way as Mocking board but transparent way to control YM2413 chip.
  - For 'Native mode' , you can control as 2nd AY3-8910 but, register number is start from 128-. For example, Register #128 is Register #0 of YM2413, Register #129 is heading to Register #1 of YM2413 and so on.
  - So, with this say, you can control YM2413.
  - YM2413 Reset is same as Mocking board
  - Register are write only

※ Controlling SD Music card is can be done same way of Mocking board. it's easy to use with old software. But, it can't use all of functions of YM2413 and sound may limited under mocking board control. So I suggest to try to use 'Native mode' for full control. It is logically separated and located 2nd AY3-8910 Register number 128(MSB).

Sample routine code

- INIT ; Init of 6522 (once required)

```
LDA #$FF
STA DDRA; $C403
LDA #$07
STA DDRB; $C402
RTS
```

- RESET; Reset AY3-8910

```
LDA #$00
STA ORB  ;$C400
LDA #$04
STA ORB  ;$C400
RTS
```

- Store data for Register
- LDA #11(Data)

```
STA ORA; $C401
RTS
```

- Use data for Register number

```
LDA #$07
STA ORB  ;$C400
LDA #$04
STA ORB ;$C400
RTS
```

- Use data for Register data

```
LDA #$06
STA ORB ;$C400
LDA #$04
STA ORB ;$C400
RTS
```

※ This way is the same as Mocking board

1st 6522 base address $Cn00

2nd 6522 base Address $Cn80
(n is slot number)

6522 Register table

Table 1. R6522 Register Addressing

Register Number	RS Coding				Register Desig.	Register/Description	
	RS3	RS2	RS1	RS0		Write (R/$\overline{W}$ = L)	Read (R/$\overline{W}$ = H)
0	0	0	0	0	ORB/IRB	Output Register B	Input Register B
1	0	0	0	1	ORA/IRA	Output Register A	Input Register A
2	0	0	1	0	DDRB	Data Direction Register B	
3	0	0	1	1	DDRA	Data Direction Register A	
4	0	1	0	0	T1C-L	T1 Low-Order Latches	T1 Low-Order Counter
5	0	1	0	1	T1C-H	T1 High-Order Counter	
6	0	1	1	0	T1L-L	T1 Low-Order Latches	
7	0	1	1	1	T1L-H	T1 High-Order Latches	
8	1	0	0	0	T2C-L	T2 Low-Order Latches	T2 Low-Order Counter
9	1	0	0	1	T2C-H	T2 High-Order Counter	
10	1	0	1	0	SR	Shift Register	
11	1	0	1	1	ACR	Auxiliary Control Register	
12	1	1	0	0	PCR	Peripheral Control Register	
13	1	1	0	1	IFR	Interrupt Flag Register	
14	1	1	1	0	IER	Interrupt Enable Register	
15	1	1	1	1	ORA/IRA	Output Register A*	Input Register A*

NOTE: *Same as Register 1 except no handshake.

AY3-8910 Register table

Fig. 3 PSG REGISTER ARRAY

REGISTER \ BIT		B7	B6	B5	B4	B3	B2	B1	B0
R0	Channel A Tone Period	8-BIT Fine Tune A							
R1		4-BIT Coarse Tune A							
R2	Channel B Tone Period	8-BIT Fine Tune B							
R3		4-BIT Coarse Tune B							
R4	Channel C Tone Period	8-BIT Fine Tune C							
R5		4-BIT Coarse Tune C							
R6	Noise Period	5-BIT Period Control							
R7	Enable	$\overline{\text{IN/OUT}}$		$\overline{\text{Noise}}$			$\overline{\text{Tone}}$		
		IOB	IOA	C	B	A	C	B	A
R10	Channel A Amplitude	M	L3	L2	L1	L0			
R11	Channel B Amplitude	M	L3	L2	L1	L0			
R12	Channel C Amplitude	M	L3	L2	L1	L0			
R13	Envelope Period	8-BIT Fine Tune E							
R14		8-BIT Coarse Tune E							
R15	Envelope Shape/Cycle	CONT	ATT.	ALT.	HOLD				
R16	I/O Port A Data Store	8-BIT PARALLEL I/O on Port A							
R17	I/O Port B Data Store	8-BIT PARALLEL I/O Port B							

YM2413 Register map

YAMAHA **YM2413**

■ **REGISTER MAP**

Address	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
00	AM	VIB	EG-TYP	KSR	MULTI				User Tone Register
01									
02	KSL			TL					
03				DC	DM	F	B		
04	AR				DR				
05									
06	SL				RR				
07									
0E			R	BD	SD	TOM	T-CT	HH	Rhythm Control
0F	TEST								OPLL Test Data
10 ~ 18	F-Num. 0 ~ 7								F-Number LSB 8 bits
20 ~ 28			SUS ON/OFF	KEY ON/OFF	BLOCK 0 ~ 2			F-Num 8	F-Number MSB, Octave set Key ON/OFF Register Sustain ON/OFF Register
30 ~ 38	INST.				VOL				Instruments Selection and Volume Register

Register of YM2413 for User define and percussive instruments

■ **REGISTER MAP**

Address	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
00	AM	VIB	EGTYP	KSR	MULTI				User Tone Register
01									
02	KSL		TL						
03				DC	DM	FB			
04	AR				DR				
05									
06	SL				RR				
07									
0E			R	BD	SD	TOM	T-CT	HH	Rhythm Control

- $0E: Percussion instrument ON/OFF
- $36~$38; Sound level of percussion instrument.

Addr	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
$36					BD			
$37	HH				SD			
$38	TOM				T-CYM			

Other information

- SD MUSIC CARD used Ym2413(OPLL) for sound generation
- AVR Atmega128 used for main controller.
- SD Music card doesn't support speech.
- No stereo sound.
- Noise emulation isn't the same as mocking board.
- Limited support of Envelope (noise only)
- SD Music is an new sound card and compatible for mocking board software.
- SD Music card is based on Lovely system's(Korean brand) mocking board
- Components values may changed without notice.
- Warranty is 3 months and not included shipping costs. After this period may charged costs for repair service.
- Disassemble or modification may expire the warranty.
- Any question for concerns, please email me quick09@gmail.com
- Thanks for purchasing

Ian Kim

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